

2009 Restoration Thinning Project Plan and Results



Table of Contents

1.0	Introduction and Background	2
1.1	<i>Project Context</i>	2
2.0	Objectives and Methods	4
2.1	<i>Additional Objectives and Methods for 2009</i>	4
2.2	<i>Landscape Perspective.....</i>	5
3.0	Unit Summaries.....	6
3.1	<i>Unit 7 (310 acres)</i>	6
3.2	<i>Unit 13 (40 acres)</i>	15
3.3	<i>Unit 15 (196 acres)</i>	18
3.4	<i>Unit 39 (63 acres)</i>	23
3.5	<i>Unit 54 (205 acres)</i>	27
4.0	Slash Treatment	30
5.0	Planting.....	30
6.0	Treatment Diagrams.....	31
6.1	<i>Snow gaps for unit 7.10</i>	32
6.2	<i>15' +/- 5' spacing for units 15.3, 39.4 and 54.2</i>	32
6.3	<i>30' diameter gridded gaps and skips for unit 39.2</i>	33
7.0	Threatened Species Protections	33
7.1	<i>Marbled Murrelet.....</i>	35
7.2	<i>Northern Spotted Owl</i>	35
7.3	<i>Northern Goshawk.....</i>	36
8.0	Literature Cited	36

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1.0 Introduction and Background

Upland Restoration Thinning is the thinning of dense second- growth forests generally less than 30 years of age that have relatively low biological diversity and are in or approaching the competitive exclusion stage of forest succession. The 2009 Restoration Thinning Project Plan defines objectives and methods of the restoration thinning program, provides detailed descriptions for individual units along with supplemental documentation, special sections planting and slash treatment and a decision model for protection of sensitive species. Overviews from the Habitat Conservation Plan (HCP) and restoration thinning candidate pool are presented as appendices to this plan. A record of accomplishments and lessons learned will be incorporated into this plan at the end of 2009 to described accomplishments and lessons learned.

1.1 Project Context

The project planning area is located in the upper Rex and Pine Creek drainages ranging in elevation from 3,000' to 4,400'. A small portion of the project area extends into the Green River drainage. In 2001, 650 acres in the middle of the project area were thinned to 15'x15' spacing with a maximum diameter cut limit of 7". The result of this thinning effort is a uniform forest with occasionally pre-existing open meadows located throughout the thinned area. The 2009 project will thin or place into reserve, following candidate selection criteria (see Appendix A), the remaining eligible areas in the upper part of Rex and Pine Creek drainages (Figure 1).

Significant old-growth forest and special habitat areas (e.g. meadows, rock, ponds) are present throughout the upper Rex basin as well as adjacent Findley and Seattle Creeks. The Landscape Synthesis Framework identified this area as a high Synergy Site. Following the restoration thinning candidate pool development process, these stands generally ranked high-priority (Ranks of: 7, 13, 15, 39 and 54 out of 137 total stands). Marbled murrelets are known to occupy the old-growth forest in the Rex basin. Though northern spotted owls have not been detected here in the last couple of decades, the old-growth in the basin is the oldest in the watershed. Numerous wet meadows are scattered throughout the planning area, which are important to many species including amphibians. Elk also use the area extensively as a summer forage and birthing ground.

The Restoration Thinning Project Team is considering units for future thinning projects on the ridge separating the Rex and Findley drainages along the 300 and 320 roads (Units 73, 98, 104, 116, 117, 127, and 131). These future restoration thinning units adjoin old-growth forests in the Findley Creek basin on the east and are near the 700 Road ecological thinning units to the northwest. Both Lindsay Creek to the west and Seattle Creek to the east were restoration thinned previously throughout a significant portion of their drainages.

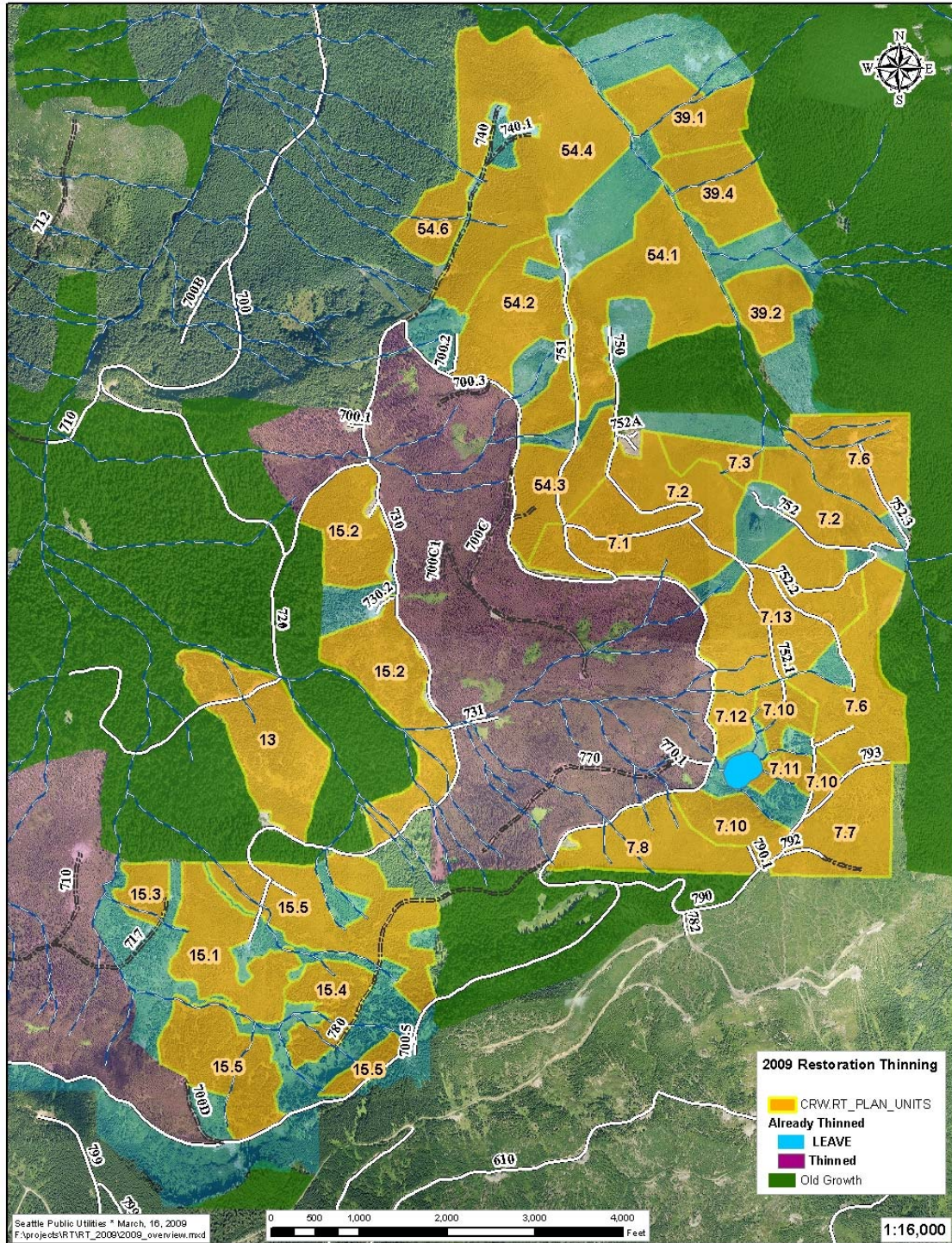


Figure 1. Overview of 2009 Restoration Thinning Project area.

2.0 Objectives and Methods

The overarching goal of restoration thinning is to accelerate the development of complex habitat in the near-term and late-successional and old-growth forest conditions in the long-term. Objectives of restoration thinning include:

- Reduce competition among trees;
- Increase light penetration;
- Stimulate tree growth;
- Increase tree and understory plant species diversity;
- Reduce long-term fire hazard;
- Increase resilience to catastrophic windthrow, insect, or disease outbreak;
- Accelerate forest development beyond the competitive exclusion stage towards a more biologically diverse stage, and/or;
- Extend the forest development stand initiation stage such that diverse species become established and diverse stand structures develop.

2.1 *Additional Objectives and Methods for 2009*

The prescriptions for 2009 restoration thinning treatments continue to focus on achieving the ecological objectives listed above. Additional objectives considered in 2009, followed by methods used to achieve those objectives, include:

- Provide development pathways for variable forest stand structures;
 - Variable residual tree densities and tree sizes; stand scale reserves; numerous skips and gaps of varied sizes; alternating stream skips and linear contour skips
- Connectivity for amphibian migration between existing patches of old-growth, wet meadows and other wetland habitats, and streams;
 - Linear contour skips; large reserves and alternating stream skips
- Connectivity and varied structure of riparian areas; minimize sediment from entering streams;
 - Alternating stream skips; higher tree densities above the inner gorge buffers
- Reduce fire danger to critical assets (such as old-growth and Rex pond) and provide access to big huckleberry stands for picking;
 - Lop and pile slash next to old-growth, forest roads and in big huckleberry picking areas

- In wetland and wet meadow areas increase annual snow accumulation thus prolonging snow melt into the spring and summer;
 - Circular and rectangular snow gaps on north facing slopes upslope of wetlands and wet meadows
- Enhancing near-term benefits to old-growth and special habitats;
 - Matching overstory tree densities in restoration thinning units to that of adjacent old-growth; incorporate special habitats or key landscape features as skips or create variable treatments around special habitats
- Increase tree species diversity;
 - Targeted thinning of most dominant species, Pacific silver fir; plant site appropriate tree species in gaps, stream corridors, decommissioned roads and yarding corridors
- Increase browse potential and access for ungulates;
 - Thin to lower densities in areas where elk frequent; incorporate gaps in areas where elk frequent; skips along streams or in corridors for cover
- Maintain cultural resources.
 - Inform crews of cultural resource protection protocol; pull slash away from cultural resource identified trails if located; monitor work with a sensitivity to cultural resources

2.2 *Landscape Perspective*

Each unit can be characterized by its unique features and how it relates to other features on the landscape. The Rex basin contains many unique features such as the pond, wet meadows, shrub openings, and rock outcroppings as well as many stands of old-growth forest adjacent to and within the planning area. Three key landscape criteria shaped the thinking behind individual thinning prescriptions or decisions to place areas in a Reserve:

- Individual unit objectives and unique features, i.e. What special characteristics does a particular unit have when compared to other units and how should the unit objectives be tailored to protect, enhance, and promote those features?
- The location and characteristics of old-growth forests and special habitats relative to the thinning units, i.e. What locations and characteristics of nearby old-growth and special habitats are unique that we should consider them in the prescriptions?
- The proximity and location to previously thinned stands, i.e. What should we be doing differently now considering the prescriptions and ecological response of nearby previously thinned stands

3.0 Unit Summaries

This section provides the following information specific to each unit:

- Unit history and context;
- Stand descriptions and data summaries;
- Unit specific objectives and prescriptions.

Detailed prescriptions, pretreatment data summaries and unit specific objectives are provided for each unit.

3.1 Unit 7 (299 acres)

Summary

Unit 7 encompasses the upper reaches of the Rex basin surrounding Rex Pond and the upper reaches of Pine Creek downstream of the old-growth. Harvest took place between 1970 and 1984, a fourteen year period. Regeneration is dominated by silver fir with smaller amounts of western hemlock. Tree heights vary from 10-40' in height and are tallest near Rex Pond, near the wet meadow/alder patch above the 700 road and above the end of the 752 road. Oval leaf and Alaska huckleberry are a major component of the understory throughout the unit with the exception of big huckleberry and bear grass dominating two areas (Units 7.1 and 7.7). Very few areas are closed canopy but those that are generally show the greatest tree height. Tree densities are high enough (>500 tpa) in most locations for thinning to be considered but certain areas show densities low enough (<100 tpa) to leave. Muckleshoot Indian Tribe (MIT) data shows elk use to be limited in the unit compared to the down slope 2001 thinned areas. A concentration of elk use does exist in the northeast corner near Pine Creek and around Rex Pond.

Objectives specific to Unit 7

- Provide shade to Rex Pond while increasing tree growth around the pond;
- Minimize erosion into pond;
- Delay snow melt into Rex Pond;
- Provide refuge habitat for wildlife in the wet meadow/alder patch;
- Expand light resources to big huckleberry and improve accessibility for pickers.

Pre-treatment data

n=12	TPA	TPA Range	DBH (in.)	HT (ft.)	LCR (%)
all trees	3,200	500-8,500	1.5	9	85
silver fir	2,700	500-8,500			
mountain hemlock	450	0-3,500			
Douglas-fir	50	0-500			

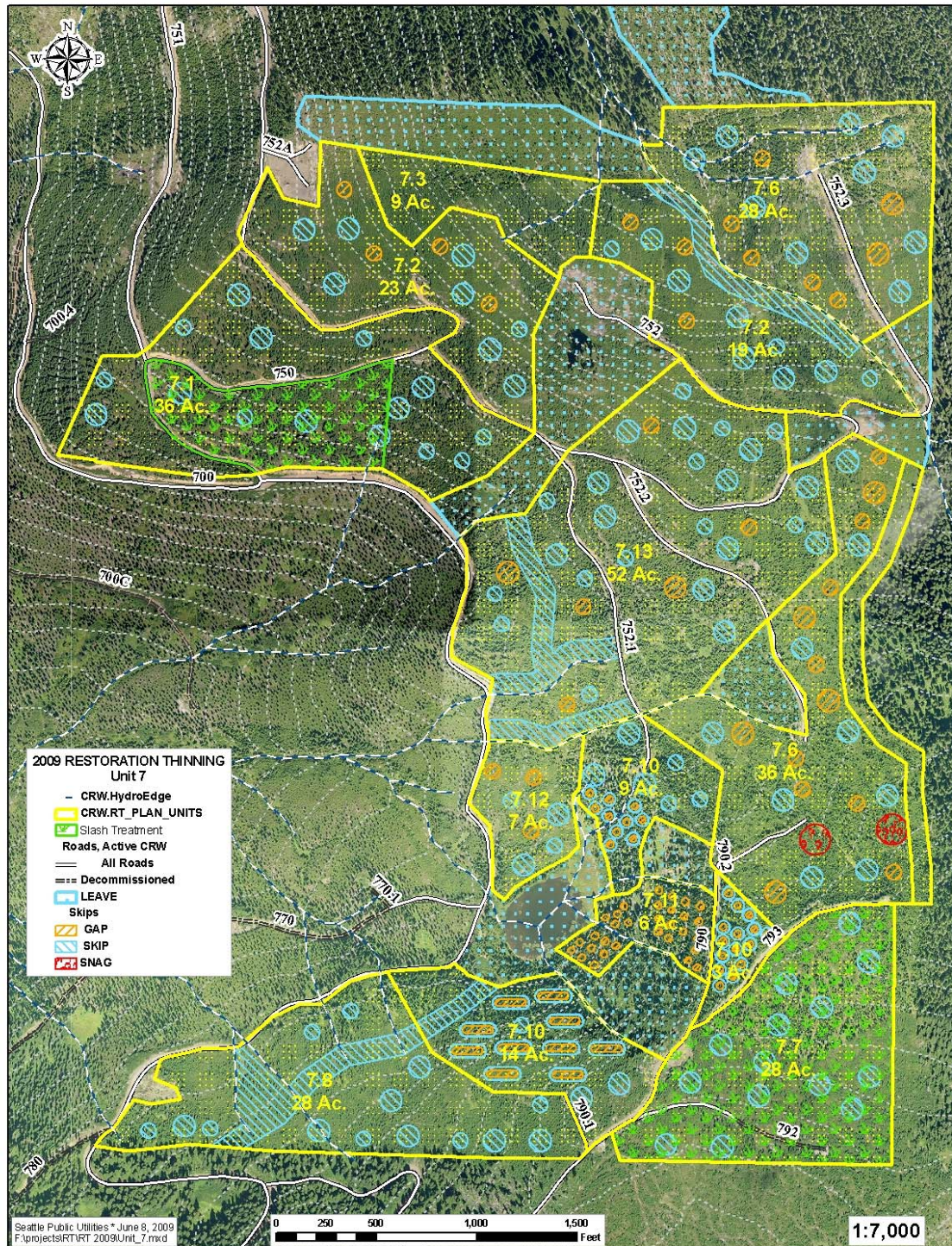


Figure 2. Unit 7.

Unit 7.1

Prescriptions

Dominated by silver fir in the overstory, big huckleberry and bear grass in the understory, Unit 7.1 is dissimilar to other areas in the Rex basin. It exists on a drier site allowing big huckleberry and bear grass to dominate instead of oval-leaf and Alaska huckleberry. Because 7.1 is readily accessible from the road and contains two species highly desired by Tribal pickers, encouraging these resources is a main objective. A 16'x16' spacing should provide 25-50% canopy cover for optimum berry production. Although tree densities are relatively high (~1750 tpa) significant open areas exist and will be enlarged by the thinning. Skips are arranged to maintain variability of tree densities.

Post-treatment data

n=12	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	217	4.9	22	84
silver fir	175	5.5	25	83
mountain hemlock	42	2.1	8	88

Compliance

There were 12 compliance plots and 10 additional tally plots installed with a passing rate of 90%. All skips and gaps were located as mapped. Contactor had some issues using ghost trees for spacing purposes in the southwest portion of the stand which resulted in more trees being cut than desired; the upper portion had slightly too many trees left. Piles were slightly larger in some cases than prescribed but allowed for fewer piles. Overall the stand meets the prescribed objectives.

Post-treatment description

One of the main objectives was to increase the productivity of huckleberries for pickers. A 16'x16' spacing was desired to provide a good amount of sun/shade; the result was nearly a 14'x14' spacing. The stand retained some of the clumpy pattern present before thinning but greatly increased the amount of open area. Due to current tree sizes, many places may be too open resulting in poor production; however, tree growth will increase shade providing excellent growing sites. Piling met plan objectives of allowing access and increasing growth.

Unit 7.2

Prescriptions

Oval-leaf and Alaska huckleberry dominate the understory with an overstory of silver fir and mountain hemlock in sometimes very dense patches (5000 tpa). A large rock outcropping divides the two parts of 7.2 with an eight acre Reserve centered around the rock and a small patch of large trees. A stream skip along Pine creek is placed on the south side of the stream (rather than the north side in Unit 7.6) to provide the coolest possible refugia and travel corridor for amphibians. Numerous skips and a small number of gaps in a relatively dense forest will increase the horizontal variability of trees within and between patches.

Post-treatment data

n=13	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	346	2.4	11	82
silver fir	188	2.9	13	81
mountain hemlock	154	1.6	8	83
western hemlock	4	1.0	8	80

Compliance

This unit contains 13 compliance plots and 8 additional tally plots with a 91% quality rating. All skips and gaps were placed as prescribed and the 100' skip along the east boundary was adequate. The contractor had some difficulties ignoring larger 8"+ trees for spacing purposes and over cutting some areas. Despite the difficulty of steep terrain, the work in this stand achieved the prescribed objectives.

Post-treatment description

Many more trees were retained than the prescription of 16'x16' spacing would have suggested. Most of these additional trees were mountain hemlock with very few over 8" dbh; presumably these were cut. Diversity of tree species changed greatly although silver fir is still the largest component with a larger average diameter and height.

Unit 7.3**Prescriptions**

The main focus of Unit 7.3 is a small (<10 acres) stand of conifers that is taller and more closed canopy than the surrounding forest. Since this stand is considerably different from adjacent stands, maintaining inter-stand structural variability is a main objective. The intention is to create a small number of dominant trees surrounded by edge trees within a matrix of dense forest. The resulting stand structure and developmental trajectory will be much different from the surrounding stands of open grown trees.

Compliance

Field verified existence of 108 gaps. Difficult to count them individually, however had contractor re-work areas lacking gaps. This stand met the prescribed objectives.

Post-treatment description

While the differences between unit 7.3 and the surrounding stands increased post-thinning, the size of the densely forested stand shrunk. When using this prescription in future thinnings, the boundaries of the unit should be increased to include the smaller surrounding forests. This would eliminate the sharp line between taller, dense stand and the shorter, open stand. In between would be a short, dense stand that is a transition between the two types.

Unit 7.6

Prescriptions

Silver fir along with shrub dominated areas of oval-leaf and Alaska huckleberry comprise this stand. Tree densities are highly variable with dense, closed canopy patches and open, huckleberry dominated patches. A narrow tree spacing is prescribed here for several reasons. The main reason is that Unit 7.13 was prioritized to have a wide spacing and this unit provides inter-stand variability of tree densities compared to 7.13. Second, a narrow spacing in this spatially patchy unit means that shrub dominated areas without trees will not increase as much as under a wider spacing. Numerous gaps, along with skips, will increase the patch variability. Nearly one mile of old-growth forest edge abuts Unit 7.6 with the northern section having tight spacing and the southern section having wide spacing. Historic air photos from 1970 show this wide tree spacing stretching north and west from the current old-growth into Units 7.6 and 7.13. In order to “soften the edge” between a widely spaced old-growth and a potentially closed canopy second-growth, a 100’ strip of 18’x18’ spacing will be created along the eastern boundary.

Post-treatment data

n=16	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	356	2.5	12	83
silver fir	325	2.5	12	83
mountain hemlock	31	2.7	12	84

Compliance

Sixteen compliance plots and 13 additional tally plots were installed. This unit passed compliance with 91%. All skips, gaps, and snag patches were located in their prescribed locations. The unit was thinned to 12’x12” spacing with a 100’ wide strip of 18’x18’ adjacent to the old growth in the southeast portion of the unit. The unit achieved the prescribed objectives.

Post-treatment description

Unit 7.7

Prescriptions

Similar to Unit 7.1, 7.7 contains a substantial amount of big huckleberry and bear grass. Numerous historical accounts describe Smay Creek Pass as a place where huckleberries were picked. A historic trail connecting the Cedar and Green rivers runs through the unit. Aerial photos of the original forest show this unit to have many tree free openings in addition to numerous widely spaced trees. The combination of open grown trees, flat ground, convenient vehicle access and abundant huckleberry resources make this an ideal location to enhance berry production for Tribal pickers. Slash will be lopped and placed into piles for improved access as part of the Restoration Thinning Slash Treatment Program.

Post-treatment data

n=10	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	470	2.5	11	80
silver fir	170	3.3	14	78
mountain hemlock	300	1.5	18	82

Compliance

This unit had 10 compliance plots and 9 additional tally plots installed with a passing quality rating of 92%. Locations and existence of a skips was field verified and acceptable; no other issues were noted in this stand. This unit achieved the prescribed objectives.

Post-treatment description

Similar to unit 7.1, the size of open areas increased dramatically while the clumpy spacing was made more uniform. Many clumps of mountain hemlock remain with average silver fir density exactly 16'x16'. Again, some huckleberries may currently receive too much sunlight but it should move towards ideal levels as trees increase shading. One method for limiting the expansion of already open areas is to prescribe a range of tree spacings centered on an average (e.g., spacing between 10' and 20' for a 15' average where it is possible to leave trees closer together when bordering an opening). Piles were sometimes too large in diameter but generally these large piles were placed atop large trees thereby necessitating larger piles.

Unit 7.8**Prescriptions**

Unit 7.8 is a connecting corridor between old-growth and meadows to the southeast and Rex pond to the northeast. To preserve this corridor for amphibian travel we placed a linear skip along the contour between the two. The old-growth forest to the south is small in size and has a highly fragmented edge. One objective is to reduce any sharp transition from second-growth to old-growth. This "softening of the edge" is accomplished with numerous skips adjacent to the old-growth within a matrix of wide spacing.

Post-treatment data

n=11	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	445	2.3	11	76
silver fir	168	3.6	15	77
mountain hemlock	277	1.1	7	75

Compliance

This unit contains 11 compliance plots and 8 tally plots with a passing compliance of 95%. As noted, due to heavy brush many smaller trees were presumably missed by the thinners. All circular skips were located as mapped, however the linear contour skip was located 100' northeast of the prescribed mapped location. Regardless, the stand met the prescribed objectives.

Post-treatment description

The spacing prescription was 18'x18' but an added restriction to only cut silver fir and leave all trees above 6" dbh greatly increased the residual density as well as altering species diversity. If only silver fir trees less than 6" dbh are counted, average spacing is wider than 18'x18'. Although a wider spacing was originally desired, a patchy structure resulting from mountain hemlock retention will aid connectivity between the old-growth and Rex pond. This is of a wide spacing on less desirable trees along with species and diameter restrictions can be used to great effect to alter species composition and increase relative clumpiness of minority tree species.

Unit 7.10

Prescriptions

The objective of snow gaps is to increase snow accumulation by reducing canopy cover and to delay snow melt by creating canopy shade on the south side of the gap. Increased snow accumulation is achieved through minimizing evaporation in the tree canopy which is directly correlated with canopy leaf area. Delay of snow melt is achieved through reduction of short wave radiation (shading). The shading effect will increase with growing canopy height but snow accumulation will also decrease as tree crowns widen. Delayed snow melt is expected to increase summer base flows. Upslope of Rex Pond, thinning in the dense closed canopy stands maintains tree growth with snow gaps, including interior leave trees and exterior buffers, adding structural complexity.

Post-treatment data

n=10	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	260	4.9	21	76
silver fir	220	5.1	22	75
mountain hemlock	35	3.9	16	78
western hemlock	5	4.0		

Compliance

Compliance installed 10 compliance plots and 7 additional tally plots for a passing rating of 93%; after the contractor reworked it. Although this unit passed compliance protocols, several of the prescribed objectives were not met. This stand required east-west elongated gaps and circular gaps with a 16' buffer around each. The contractor struggled with elongated gaps and buffers on all gaps leaving them too wide. Contractor initially left all trees 6" dbh or greater in gaps. Contractor neglected to leave the 100' linear contour skip located in the south polygon of the stand. The west portion of the south polygon was over-cut with contractor cutting all trees with the exception of ghost trees. Compliance in the portions to the east and north of Rex pond were much better mostly due to the absence of the difficult to implement snow gaps.

Post-treatment description

The implementation snow gap prescriptions proved to be very difficult. Thinnerers were often confused which side of the gap buffer they were on resulting in many buffers wider than 16'. For future use, snow gaps should be spaced further apart and possibly flagged by staff. The effect on the landscape as seen from the opposite hill is one of high spatial diversity. It is this gap within a skip surrounded by matrix thinning that creates the high diversity. While the chaos of implementing the snow gaps did not fully achieve the objective, spatial diversity was increased dramatically.

Unit 7.11

Prescriptions

Unit 7.11 encompasses the southern half of the forest edge along Rex pond and the hillside above to the east. The main objectives are to protect the pond from any increases in sedimentation, shade the pond, maintain tree growth adjacent to the pond and delay snow melt above the pond. Similar to 7.10, 35' dia. circular gaps will supply snow melt later in the year to Rex pond and the adjacent meadows and streams downhill. Approximately 20-30 trees in Unit 7.11 based on height, proximity to the pond and location relative to desired leave trees will be selectively felled into Rex pond. Tree boles and branches are known to provide egg attachment sites for breeding amphibians. Falling trees into the pond should improve in-pond amphibian habitat with residual trees adjacent to the pond continuing to provide shade.

Compliance

This unit contains 10 tally plots throughout the unit. Of all 10 plots, only 2 fell within gaps. Contractor installed 32 gaps which were deemed acceptable. This unit meets the prescribed objectives.

Post-treatment description

Unit 7.11 is very steep and densely forested. Slope integrity was maintained through this prescription while also increasing edge trees and within stand patchiness. The number of trees located next to the pond suitable for felling to create amphibian habitat were one-third the expected amount. In many cases trees were situated too far away to reach the water.

Unit 7.12

Prescriptions

A dryer site than the neighboring areas, Unit 7.12 is high ground surrounded by meadows, pond and creeks. Objectives for this unit are for increasing tree species diversity, increasing tree growth and maintaining the horizontally patchiness of trees. Several large skips will maintain dense patches near the pond; small gaps will open up areas for planting of underrepresented species. A thinning from below of only silver fir will preserve the dominant trees, increase tree growth, and enhance other species.

Post-treatment data

n=5	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	350	2.5	11	79
silver fir	290	2.4	10	78
mountain hemlock	50	2.8	18	85
Douglas-fir	10	4.0	22	90

Compliance

There were 5 compliance plots and 5 additional tally plots installed in this unit. Unit 7.12 failed compliance with 84%. All skips and gaps were field verified and deemed acceptable in size and location. Stand had an unacceptable excess of smaller silver fir left throughout as well as high stumps. This unit did not meet the prescribed objectives to the desired level. A rework was not requested because the overcutting at the bottom balanced out with the slight amount of excess trees at the top of the unit. Contractor was paid at the 84% rate.

Post-treatment description

Contractor quality was very poor in the unit. At the bottom mountain hemlock were cut where none should have been. Near the top small areas contained silver fir at spacing less than 10'x10'. Obviously, the desired objectives were to retain the mountain hemlock and decrease silver fir. A pre-work meeting before beginning the stand, as well as verifying that the contractor has a copy of the prescriptions and contract, would have prevented the over cutting.

Unit 7.13**Prescriptions**

The widely spaced trees and meadow openings that start in Unit 7.6 move northwest extending into much of Unit 7.13. The openness of the trees can partially be explained by wet meadow conditions. However, many drier areas that are now forested were open in 1958, and to lesser extent in 1970. Present day tree spacing is clumpy, mostly silver fir, with oval-leaf, Alaska, and big huckleberry throughout. MIT elk data shows two concentrations of use around 7.13: below the 700 road in the 2001 thinned stands and east in the old-growth forest around Pine creek. While this data is preliminary and inconclusive, giving 7.13 a wide spacing should encourage use and increase forage opportunities.

Post-treatment data

n=17	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	382	2.6	12	76
silver fir	176	3.0	12	76
mountain hemlock	194	1.5	9	77
noble fir	12	4.8	20	82

Compliance

This unit had 17 compliance plots and 13 additional tally plots installed passing with 93% compliance. All skips and gaps were located close to their prescribed location. Contractor left some mountain hemlock in a few of the gaps and several noble fir were observed cut on the ground. The 100' wide linear contour skip was located about 100' to the west of its prescribed location.

Post-treatment description

Prescriptions for unit 7.13 called for 18'x18' spacing, cutting only silver fir, and leaving all trees greater than 7" dbh; ignoring the latter two for spacing. For silver fir below 7" dbh the actual spacing is 16'x16', not 18'x18. It does appear that when mountain hemlock was present these trees were ignored for spacing even if the resulting spacing was too tight. Only one silver fir 7" or greater dbh was recorded. The objective of having a wide spacing was not necessarily achieved

3.2 Unit 13 (40 acres)

Summary

Old growth forest surrounds Unit 13, which is the lowest (3,000-3,500') in elevation with the highest tree species diversity of all the 2009 restoration thinning units. The unit was harvested in 1987 but appears to be a relatively high growing site considering the tree height at this age. Tree species diversity is highest in this unit and includes Douglas-fir based on 2008 field reconnaissance; however, the pre-treatment sampling did not record any. There is heavy elk use associated with the meadow located in the southern portion of the stand. In other areas of Unit 13 the trees are approaching or have reached canopy closure. Current tree densities in Unit 13 are between 500 to 10,000 trees per acre and considered high enough that thinning is needed throughout the stand with special consideration given to the meadow.

Pre-treatment data

n=5	TPA	TPA Range	DBH (in.)	HT (ft.)	LCR (%)
all trees	5,900	500-10,000	2.0	9	83
silver fir	3,300	0-9,500			
mountain hemlock	100	0-500			
western hemlock	1,900	0-5,000			
red cedar	600	0-3,000			

Objectives specific to Unit 13

- Protect streams and inner gorges;
- Protect, maintain and encourage structural diversity around meadows;
- Encourage presence and growth of minority tree species.

Prescriptions

Prescriptions for Unit 13 aim to increase species diversity of all trees except Pacific silver fir. When cutting silver fir, contractors will space silver fir away from the minor tree species (e.g. Douglas-fir, red cedar, etc.) rather than ignoring them for spacing. The variable treatment around the meadow is balancing a wide spacing for maximum tree growth and maintenance of the meadow (50' wide strip of 20'x20' spacing) with a solid forested edge for adequate shading (50' wide skip on south side of meadow). The linear contour skip connected to the alternating stream skip will connect the old-growth on either side for amphibian travel.

Post-treatment data

n=13	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	385	3.7	18	78
silver fir	177	4.2	20	77
mountain hemlock	88	1.7	11	84
western hemlock	27	3.2	17	80
Douglas-fir	65	5.1	29	76
western red cedar	27	0.5	6	77

Compliance

Here, 13 compliance plots and 11 additional tally plots were installed. This unit passed compliance with a 92%. All skips, gaps, contour skips, and stream skips were located as mapped. Considering the species mix and ghost tree requirements this stand came out very close to the objective stated in the prescription.

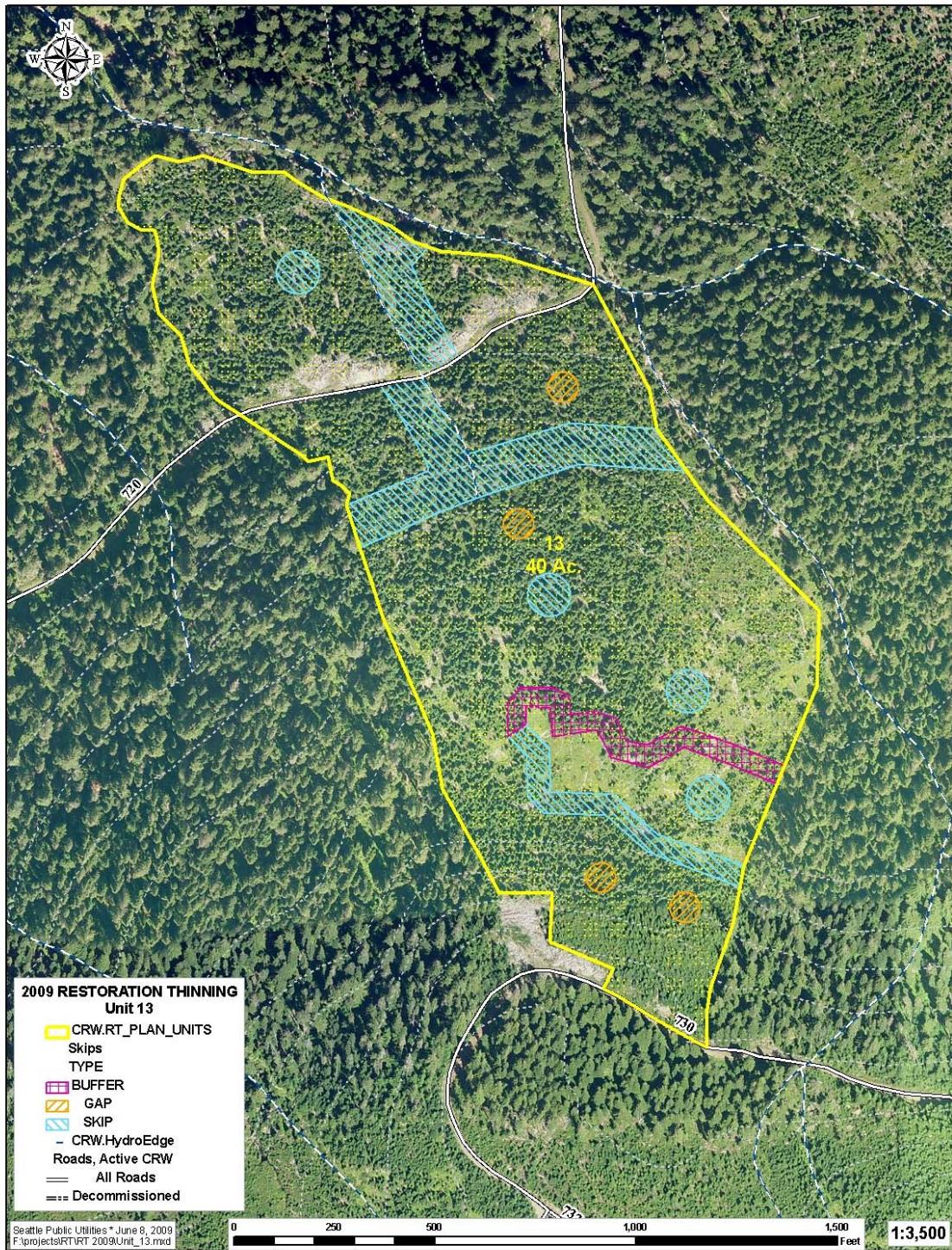


Figure 3. Unit 13.

3.3 Unit 15 (198 acres)

Summary

Unit 15 is composed of three different topographical parts: 1. flat/gently sloped bottomland containing short trees and wet meadows; 2. steep hillside with tall trees and shrub openings on the south side of the unit; and 3. moderately sloped hillside stand containing trees and meadows in between old-growth and previously thinned stands on the far north. The unit was harvested between 1973 and 1987, a fifteen year period. According to initial MIT elk GPS data, there is heavy elk use in area surrounding the wet meadows and shrub openings. Elk use also takes place throughout the unit and into adjacent old-growth and previously thinned restoration thinning units. Some areas within Unit 15 contain small trees that are widely spaced apart leading to the assumption that canopy closure may be many years away if it occurs at all. Other areas within Unit 15 containing taller trees are more closely spaced together with canopy closure already occurring. Silver fir heavily dominates tree composition with small amounts of several other species (Table 3). Tree densities range considerably throughout the unit (500 – 7,500 trees per acre). These tree densities are still high enough, in most places, to benefit from a restoration thinning.

Pre-treatment data

n=10	TPA	TPA Range	DBH (in.)	HT (ft.)	LCR (%)
all trees	2,900	500-7,500	1.9	10	90
silver fir	2,450	500-6,500			
mountain hemlock	100	0-1,000			
western hemlock	350	0-1,500			
red cedar	50	0-500			
red alder	50	0-500			

Objectives specific to Unit 15

- Protect, maintain and encourage plant diversity around meadows;
- Balance increased tree growth around meadows with uncut buffers;
- Provide untreated connectivity between individual features such as meadows and old-growth;
- Increase browse potential and access for ungulates.

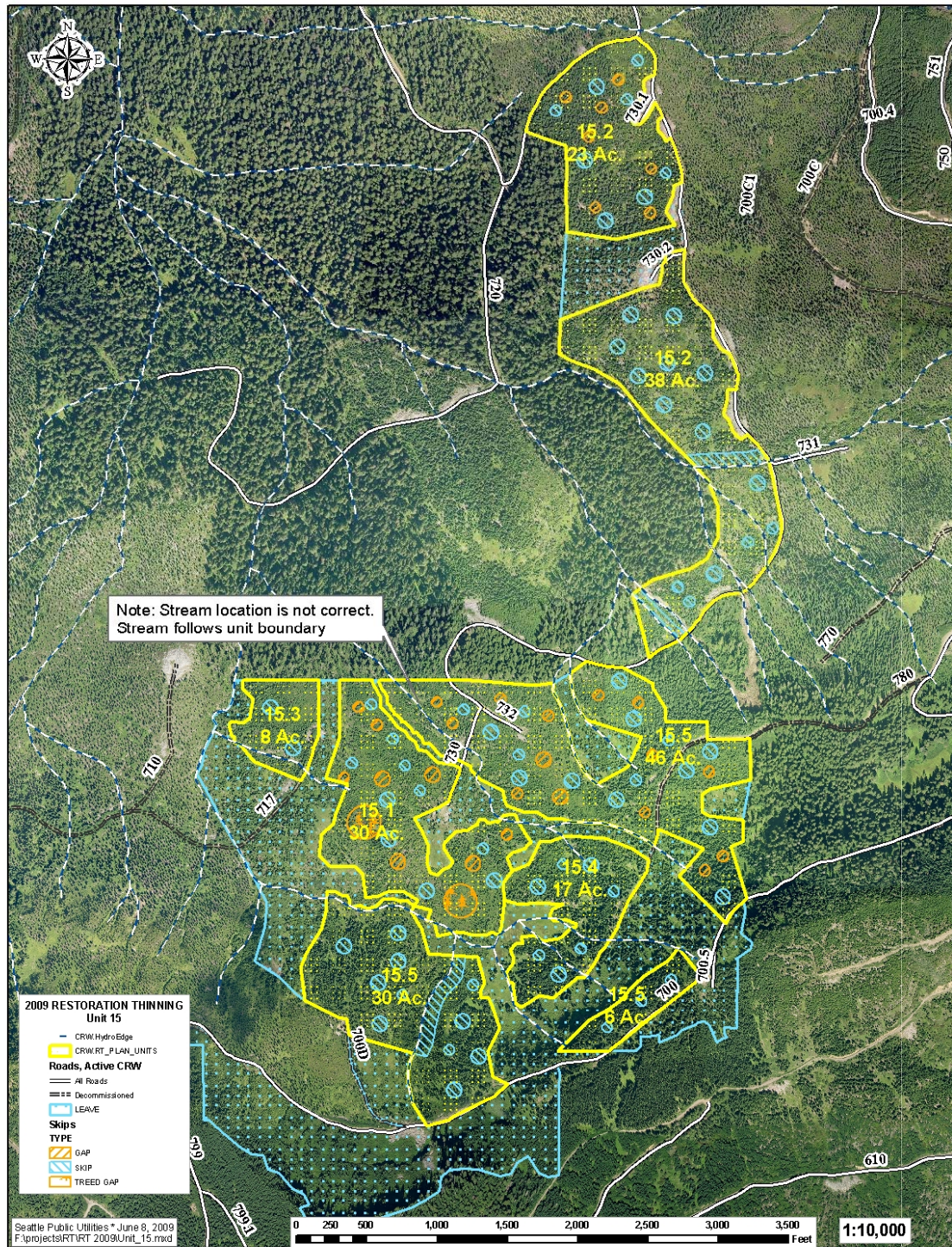


Figure 4. Unit 15.

Unit 15.1

Prescriptions

Several prominent wet meadows are within or adjacent to Unit 15.1. Few signs exist that encroachment by conifers has taken place. Flagging of project boundaries by staff will accomplish the objectives of maintaining tree growth and shade along the meadow edge by skipping some trees adjacent to the meadow and thinning others. Historic air photos indicate that the primary forest in the bottomlands had wide tree spacing with tree crowns not touching. A few locations have tree densities similar to the historical reference, but densities in other areas are above 5,000 tpa. An 18'x18' spacing matrix, numerous gaps, and two one-acre areas of 30'x30' spacing will reduce densities to approximate the historical range of densities.

Post-treatment data

n=12	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	313	3.4	18	82
silver fir	158	4.4	21	84
mountain hemlock	142	1.5	10	77
Douglas-fir	8	3.0	15	85
western red cedar	4	1.0	7	70

Compliance

This unit had 12 compliance plots and 9 additional tally plots. Stand passed compliance with 92%. All skips and gaps were field verified and deemed acceptable. The treed gap to south contained uncut scattered MH, however this was agreed to be acceptable by SPU. Spacing was wide in scattered areas throughout the stand but was typically good. The stream buffer to the NE between stand 15-1 and 15-5 was cut through in several locations. This stand met the objectives as prescribed.

Unit 15.2

Prescriptions

Tree densities in Unit 15.2 are highly variable and probably having a greater range than indicated by the 500-4,500 tpa pre-treatment data. In order to preserve this variability skips are placed in the higher density patches, stream buffers are skipped and a large six acre Reserve is created that connects the old-growth with previously thinned units. All of this is within a wide spacing of 18'x18'. Planting in conifers in gaps and deciduous species along streams will improve species diversity, help stabilize scoured streambanks, and enhance the aquatic system.

Post-treatment data

n=19	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	492	4.3	23	78
silver fir	134	4.2	22	79
mountain hemlock	76	2.8	15	85

western hemlock	211	3.3	21	77
Douglas-fir	58	8.3	39	74
noble fir	5	6.0	29	75
western red cedar	3	3.0	14	90
red alder	5	3.0	19	50

Compliance

Here, 19 compliance plots and 13 additional tally plots were installed. This unit passed compliance with a 92 %. All skips, gaps, and stream skips were located. All were acceptable, however gap locations in north polygon were a bit off (see field map). Spacing typically good but the 25' wide 10' x 10' spacing adjacent to creeks was a bit wide. Very little cutting in north polygon due to lack of Silver fir. This stand met the objectives as prescribed.

Unit 15.3

Prescriptions

Spacing of residual trees during thinning based on a certain distance can reduce inter-tree variability and create stands of trees that are uniformly spaced. Even with gaps and skips of multiple sizes, maximum diameter cut limits and species thinning preferences, inter-tree horizontal variability can become uniform. The idea for Unit 15.3 is to create a prescription that creates variability in tree spacing on a scale that varies from tree to tree, rather than from stand to stand. This is a test prescription that will require close monitoring of contractors in the field. See the diagram in Section 6.2 and the description for Unit 39.4 for more information.

Post-treatment data

n=19	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	315	4.1		
silver fir	315	4.1		

Compliance

Installed 19 compliance and nearest neighbor plots. This unit failed compliance with 86%. Stand required a variable spacing matrix with one third each at 10' 15', and 20' spacing. The contractor did not cut enough 20' X 20' spacing even after reworking the unit. Skips were located and acceptable. This stand did not quite meet the prescribed spacing objective.

Unit 15.4

Prescriptions

Unit 15.4 is a diverse unit consisting of flat bottom forest and meadow, closed canopy hillside forest and mixed forest with shrub and grass meadows. Skipped areas surrounding the unit are concentrated along streams, wet meadows and patchy forest with

shrub openings. Thinning to 16'x16' spacing will maintain and increase tree growth with gaps and skips increasing the patchy structure throughout the stand.

Post-treatment data

n=6	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	617	4.1	20	73
silver fir	208	6.4	28	72
mountain hemlock	108	2.5	15	78
western hemlock	275	2.9	17	69
Douglas-fir	25	1.3	10	80

Compliance

Here, 6 compliance plots and 5 additional tally plots were installed. This unit passed compliance with 91%. All skips were field verified and size and location were acceptable. Some changes were made to the prescription upon execution due to the amount of large SF. Contractor did not girdle SF between 7"-10", instead used them for spacing purposes. SPU agreed that this was acceptable practice in this case due to high numbers of trees in this diameter range. Overall the stand met the objectives as prescribed.

Unit 15.4

Prescriptions

Shrub dominated openings surrounded by relatively dense forests are an important feature of Unit 15.5. In order to increase the horizontal structural diversity of the unit, skips are placed in dense forest surrounded by a thinning matrix of 16'x16' spacing. Since the 2001 thinning that surrounds Unit 15 left very few areas as skips, forest to the south and west are Reserved to increase the diversity at a scale of five to 30 acres. The riparian buffer will maintain amphibian travel corridors with the thinned side of the stream maintaining tree growth.

An interdisciplinary team site visit will occur in Unit 15 to map out thinning boundaries around meadows. Objectives will be to diversity treatments on meadow edge, reduce meadow encroachment by conifers where it is observed, retain under represented tree species and retain tree shading on south and west sides of meadows.

Post-treatment data

n=27	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	393	4.3	23	77
silver fir	194	5.7	27	76
mountain hemlock	167	2.4	15	81
western hemlock	20	3.1	18	73
Douglas-fir	4	7.5	36	80
noble fir	2	4.0	14	90
western red cedar	6	1.3	8	73

Compliance

Here, 27 compliance plots and 23 additional tally plots were installed. This unit passed compliance with 92 %. Skips and gaps were checked when possible and were typically located close to mapped locations. Some changes were made to the prescription with regards to the creation of snags. The prescription called for girdling all SF between 7"-9" inches. The high number of 7"-9" of silver fir would have left large areas of girdled trees, and contractor instead girdled fewer trees and evenly dispersed them throughout the stand. SPU agreed that this was acceptable practice. Overall the stand met the objectives as prescribed.

3.4 Unit 39 (62 acres)

Summary

Unit 39 is naturally variable with dense areas dominated by silver fir, brushy patches with few trees, and rocky talus. Pine creek borders the unit at the bottom of the slope. Old-growth forest borders the unit on two sides: at the top of the slope and on the northern end of the unit. Unit 39 is a moderately sloped (~50%) southwest facing unit that was cable yarded from the adjacent ridge to the west between 1985 and 1987. No roads connect to the unit. Where canopy closure is near complete, tree densities are very high (up to 10,000 tpa) and restoration thinning prescriptions should improve tree growth and increase biodiversity. Open areas, notably the far northern end, are already at restoration thinning target tree densities and will not be treated.

Pre-treatment data

n=3	TPA	TPA Range	DBH (in.)	HT (ft.)	LCR (%)
all trees	8,825	8,000-10,000	0.8 in	7 ft	63%
silver fir	8,650	8,000-10,000			
western hemlock	175	0-500			

Objectives specific to Unit 39

- Protect brushy incised streams and rocky habitat;
- Provide undisturbed connection from old-growth to Pine Creek;
- Match tree densities of thinned stands to those of the adjacent old-growth forest;
- Compare visual outcome of different treatments from a strategic vantage point.

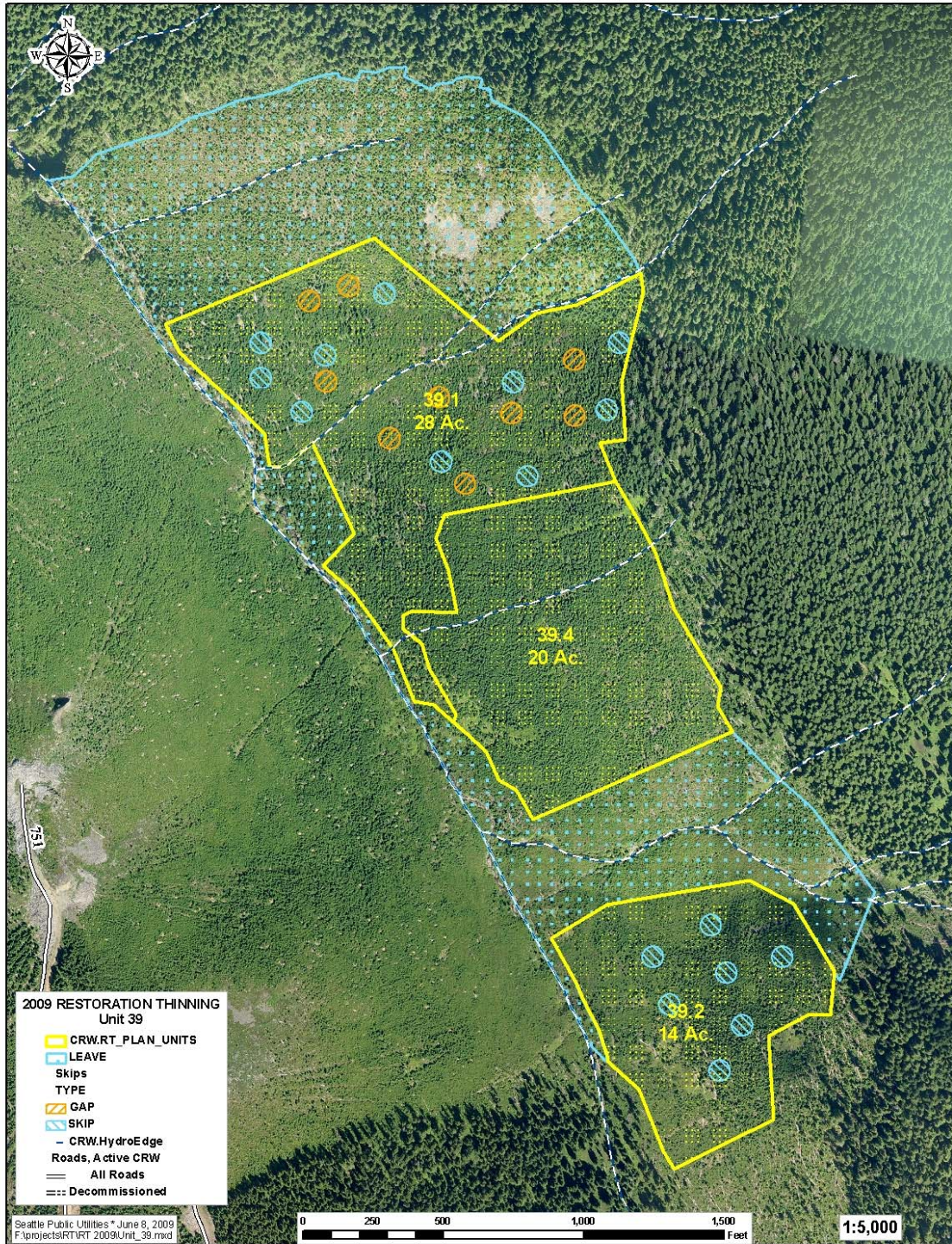


Figure 5. Unit 39.

Unit 39.1

Prescriptions

Prescriptions in Unit 39.1 represent what is now a standard prescription: spacing residual trees on a set distance, gaps and skips throughout the unit placed at “random”, and riparian buffers where no trees are cut, all adjacent to Reserves that range from several acres up to 30 acres in size. The prescription for this unit was chosen to compare this standard prescription with novel treatments (Units 39.2 and 39.4) that are still in the process of being refined. The 14’x14’ spacing is a best estimate at creating a density that will be comparable to the other treatments (see below).

Post-treatment data

n=25	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	724	2.6	14	77
silver fir	412	3.0	15	76
mountain hemlock	244	2.0	9	80
western hemlock	24	3.2	22	93
western red cedar	44	1.8	8	66

Compliance

This unit had 8 100th acre permanent fixed plots with all tree data and 17 additional count plots with species and diameter recorded. Permanent plots were marked with orange/white PVC pipe at plot center, and green paint in plot vicinity. Unit acreage was increased due to contractor cutting approximately 3 acres of adjacent stand (39.4).

The silver fir in this stand was thinned to 14x14 ft spacing. Compliance was measured at 93% for this stand. The calculated number of trees per acre was higher than the target due to some excess trees left by contractor, but mainly because all species besides silver fir were left and ignored for spacing as the prescription states. Ten 1/10th acres skips and 9 1/10th acre gaps were field verified and locations deemed acceptable.

Unit 39.2

Prescriptions

In 2008 a prescription very similar to this was attempted with the objective of creating variable tree spacings and a large number of edge trees—much different than a distance-based spacing, even with skips and gaps. A critique following a site visit last year was that tree densities looked low, or more specifically, dense patches were lacking. Changes from last year include reducing slightly the number of gaps (14 vs. 12 per acre) and adding three skips per acre (or one skip for every fourth gap). It is expected that these small gaps will close over time and not be persistent features on the landscape. See the diagram in Section 6.3 for more information.

Post-treatment data

n=15	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	440	2.5	11	76
silver fir	340	2.9	13	76
mountain hemlock	67	1.2	7	80
western hemlock	33	1.0	7	74

Compliance

Here, 5 100th acre permanent fixed plots with all tree data and 10 additional count plots with species and diameter recorded in skips, gaps, and thinned areas were installed. Permanent plots were marked with orange/white PVC pipe and green paint in the plot vicinity. Contactor was deficient in number of trees to be left, but passed compliance at 91%. Skips were located as mapped and the number and placement of gaps appeared sufficient.

Unit 39.4**Prescriptions**

The third prescription in the trial is a refinement from a treatment attempted in 2008. The objective is to create variable tree densities with patches that are 60'x60' in size. According to Larson and Churchill (unpublished manuscript) one-third of trees in late-successional silver fir forests are in clusters where trees are 10' or closer; this distribution occurred throughout their sample plots. They recommend increasing spatial heterogeneity at scales less than 1/10th acre, or about 65'x65'. Prescriptions for 39.4 estimates that 59% of trees will be spaced 10'x10'. This percentage will decrease over time due to density-dependent mortality although no modeling of stand growth over time has been conducted. See the diagram in Section 6.2 for more information.

Post-treatment data

n=37	TPA	DBH (in.)	HT (ft.)	LCR (%)
all trees	485	3.7		
silver fir	460	3.7		
mountain hemlock	9	4.0		
western hemlock	16	3.5		

Compliance

The compliance contractor installed 7 permanent 50th acre fixed plots with all tree data and 11 additional count plots with species and diameter recorded. This plot data was collected after the contractor re-entered the unit to rework. Permanent plots were marked with orange/white PVC pipe at plot center and green paint in plot vicinity. Also, nearest neighbor plots for compliance of variable spacing. Unit was reduced in size due to contractor cutting outside the boundaries in unit 39-1. Contractor re-entered the unit after compliance showed insufficient amounts of 20'X 20' spacing cutting 3 60' wide corridors of 20' x 20' spacing running north/south. Follow up compliance showed higher

than required 20' X '20 spacing. MH and WH were ignored in terms of spacing requirements. The contractor mistakenly cut MH in some areas.

39.1		gap	matrix	skip	Avg. tpa	Avg. spacing
	tpa	0	222	2000	284	12.4
	% of area	4%	92%	4%		
	# tpa	0	204	80		
	% trees	0	72%	28%		

39.2		gap	matrix	skips	Avg. tpa	Avg. spacing
	tpa	0	303	2000	327	11.5
	% area	20%	75%	5%		
	# tpa	0	227	100		
	% trees	0%	69%	31%		

39.4		20ft	15ft	10ft	Avg. tpa	Avg. spacing
	tpa	109	194	436	246	13.3
	% of area	33%	33%	33%		
	# tpa	35.97	64.02	143.88		
	% trees	15%	26%	59%		

* assumes 2000 tpa in the skips

3.5 Unit 54 (203 acres)

Summary

Unit 54 has widely variable pre-treatment canopy structure ranging from wind whipped trees, brush covered rock, and closed canopy silver fir trees. The unit was harvested between 1970 and 1987 with current tree heights generally correlating with the time of harvest. The southeast side of the ridge appears to be heavily impacted by the wind with tree crowns heavily flagged and missing many needles. Pine Creek borders Unit 54 at the bottom of the slope, old-growth forest abuts the southeast corner, and second-growth forest and previously thinned young forest occur on the west side of the unit. *Note: no thinning in Unit 54 during 2009. Currently planned for 2010.*

Pre-treatment data

n=29	TPA	TPA Range	DBH (in.)	HT (ft.)	LCR (%)
all trees	3,050	0-11,500	1.5	9	80%
silver fir	2,810	0-11,000			
mountain hemlock	225	0-3,000			
western hemlock	15	0-500			

Objectives specific to Unit 54

- Identify special features such as rocks, meadows and brushy areas and prescribe skips or reserves;
- Minimize visual presence of yarding corridors;

- Increase tree species diversity;
- Minimize further wind damage to trees.

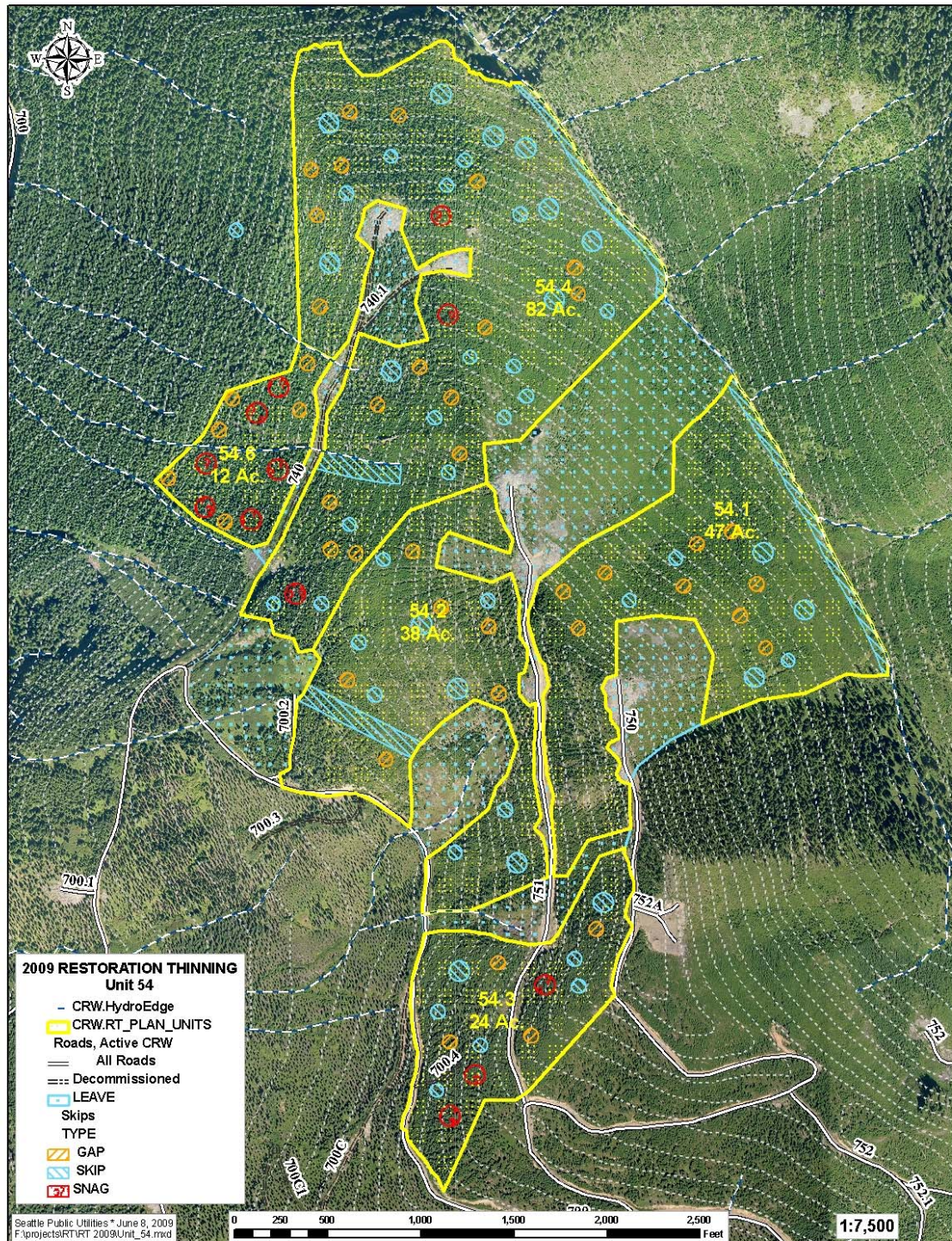


Figure 6. Unit 54.

Unit 54.1

Prescriptions

Tree densities and height growth appear to be relatively low in Unit 54.1. Second-growth forests to the northwest of this unit are very slow growing, potentially due to soil disturbance from cable yarding and loss of needles from wind. The effects within the unit do not appear to be as severe as those neighboring it. Because of the low site quality, to lessen the impact wind will have on thinned trees, and to create variability across stands, Unit 54.1 was chosen to have a narrow spacing of 12'x12'. Gaps, skips, and planting in the gaps and yarding corridors will complement the narrow spacing.

Unit 54.2

Prescriptions

Impacts from the logging can be observed in the lack of trees established in the yarding corridors and in the adjacent Reserve to the southwest that is surrounded by 54.2. Planting will occur in all gaps, yarding corridors and sparse areas throughout the unit. The remaining area is dominated by closed canopy forest. Because Unit 54.2 is not entirely homogenous, the 15' +/- 5' spacing will be tested in a different forest structure than the other two units with the same prescription (39.4 and 15.3). The linear contour skip creates connectivity for amphibian travel between the riparian areas.

Unit 54.3

Prescriptions

With relatively high tree densities, large tree sizes and almost exclusively silver fir species composition, thinning by diameter in 54.3 will create variable densities without reducing the ability of other species to grow. Skips and gaps will increase the patchy structure of the unit at a slightly larger scale than the thinning prescription. In the 1/5th acre patches, girdling trees greater than 5" dbh and leaving two trees in the middle will reduce the slash on the ground immediately after thinning and provide short-term snags for wildlife use.

Unit 54.4

Prescriptions

The largest unit at 82 acres, 54.4 encompasses the west and east flanks of the ridge separating Pine and Rex creeks. As with Unit 54.3 almost the entire unit is covered by closed canopy forests. Thinning of only silver fir by diameter will be used to increase tree growth, increase patchy structure and decrease silver fir dominance. Skips and gaps throughout the unit will increase the patchy structure further at a larger spatial scale.

Unit 54.6

Prescriptions

The trees within Unit 54.6 are too tall to thin safely and would create too much slash so instead gaps and snag patches will be made throughout this twelve acre unit. Patches 1/5th acre in size will have two trees left in the middle with trees over 5" dbh girdled and the remaining felled followed by planting. This unit is on the edge of larger forest to the north and is a transition to the smaller trees in the rest of Unit 54.

4.0 Slash Treatment

To minimize restoration thinning effects on big huckleberry growth, berry production and access, thinning related slash will be treated in the two units: 7.1 and 7.7. The treatment will require slash to be lopped and piled into 8' diameter piles. Based on the 2008 Slash Treatment Trial this appears to be the best, most cost-effective method for achieving goals of improving huckleberry access and growing conditions. Slash treatment in other areas, primarily along roads and edges between restoration thinning units and old-growth for fire protection, is still under consideration. A decision model that will provide information on the best locations and methods to treat slash is currently being constructed.

5.0 Planting

In coordination with the Upland Restoration Planting Program, the thinned matrix in several units and gaps in numerous units will be planted. Planting objectives are to diversify species composition, increase riparian cover, bank stability and nutrient inputs, and restore yarding corridors.

Different mixes of species will be used for different planting situations depending upon:

Unit #	Location	Species	Size	Spacing	# of trees
7.6	riparian	ALRU	2000 ft	12'	300
7.6	gaps	ALRU	0.1 ac	15'	60
7.6	gaps	THPL	0.1 ac	15'	40
7.6	gaps	dry mix	0.2 ac	15'	200
7.6	gaps	wet mix	0.2 ac	15'	80
7.12	gaps	dry mix	0.1 ac	15'	60
7.12	matrix		6 ac	20'	600
7.13	gaps	dry mix	0.1 ac	15'	80
7.13	gaps	dry mix	0.2 ac	15'	80
7.13	matrix		25 ac	20'	2500
15.1	riparian	ALRU	2900 ft	12'	420
15.1	gaps	wet mix	0.1 ac	15'	100
15.1	gaps	wet mix	0.2 ac	15'	160
15.1	matrix		28 ac	30'	1400
15.2	riparian	ALRU	2000 ft	12'	460
15.2	gaps	wet mix	0.1 ac	15'	140
54.1	gaps	dry mix	0.1 ac	15'	180
54.1	corridors		3 ac	15'	300
54.2	gaps	wet mix	0.1 ac	15'	120
54.2	corridors		15 ac	15'	1500
54.3	snag patch	wet mix	0.2 ac	15'	120
54.4	snag patch	PSME/PIMO	0.2 ac	15'	120
54.6	snag patch	PSME/PIMO	0.2 ac	15'	240
				Total	9260

dry mix: Douglas-fir, noble fir, western white pine

wet mix: western red cedar, western hemlock, western white pine

ALRU = red alder

THPL = western red cedar

PSME = Douglas-fir

PIMO = western white pine

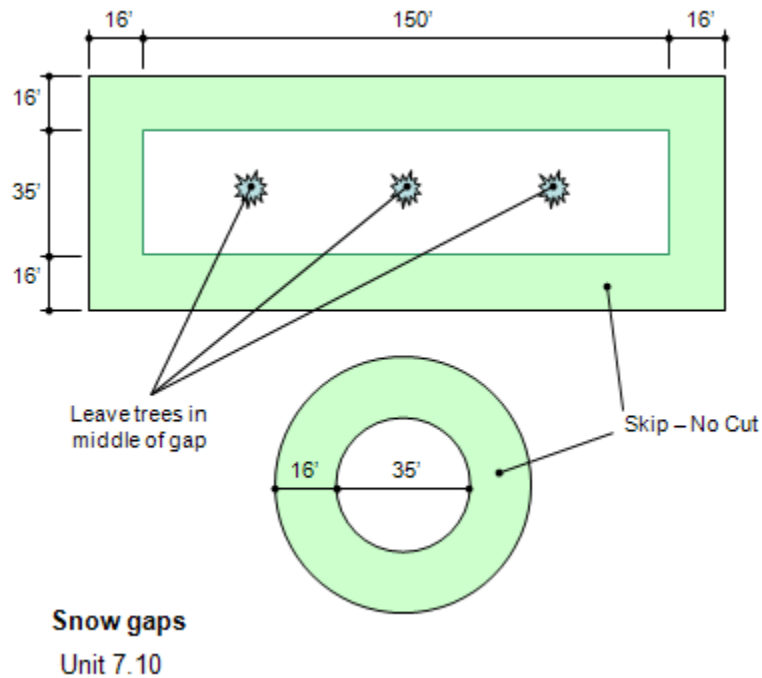
* riparian planting length measurement is for one side of stream only

6.0 Treatment Diagrams

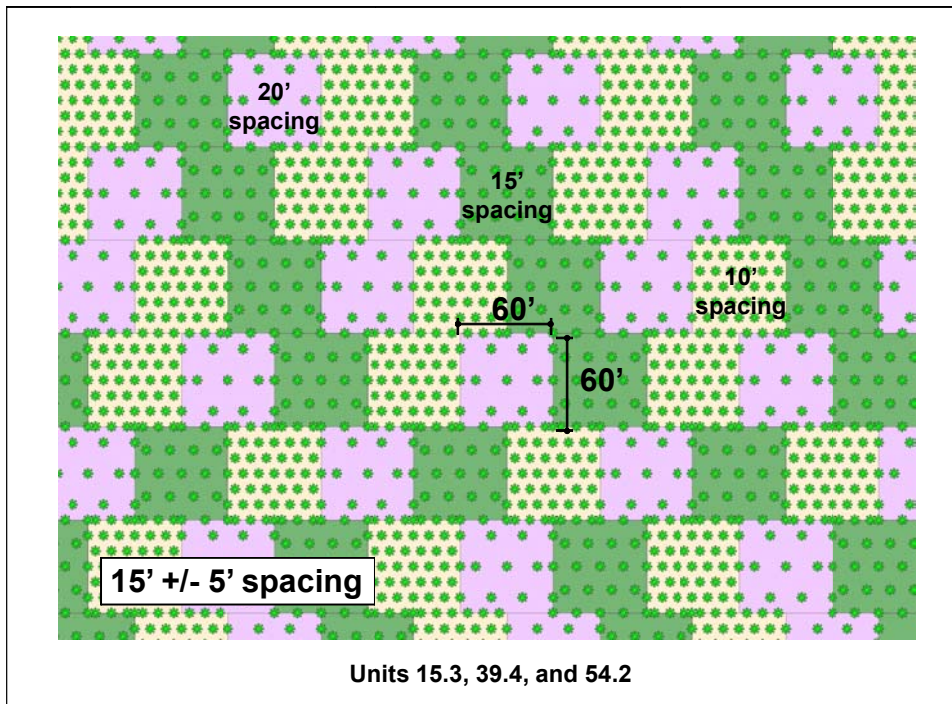
Several 2009 restoration thinning unit prescriptions are complex. The purpose of this section of the report is to provide additional visual information to better understand

specific prescriptions. What follows are three diagrams where additional information is provided regarding portions of these complex prescriptions.

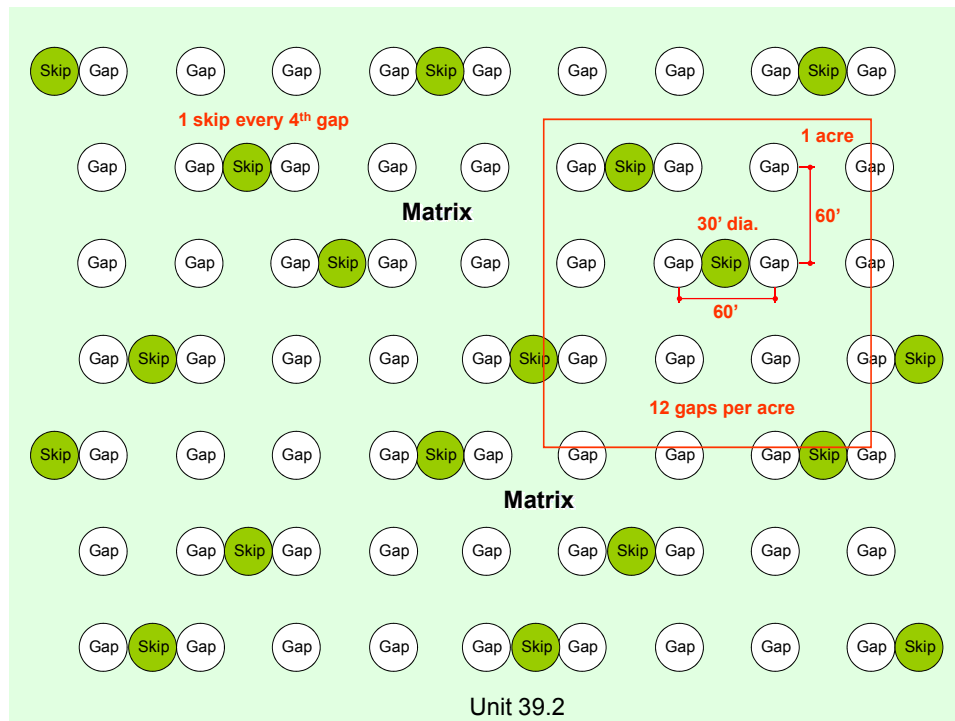
6.1 *Snow gaps for unit 7.10*



6.2 *15' +/- 5' spacing for units 15.3, 39.4 and 54.2*



6.3 30' diameter gridded gaps and skips for unit 39.2



7.0 Threatened Species Protections

All of the 2009 restoration thinning units are located close to, or adjacent to, old growth forests. Avoiding any restoration thinning operational disturbance to marbled murrelets (MAMU), spotted owls (SPOW) and northern goshawks (NOGO) occupying or nesting in these old growth forests resulted in the creation of three options.

Option 1 involves suspending work till after August 31st with no surveys conducted. This is the most cautious option because it avoids any possible impacts to threatened species in case of missed detection of threatened species. Option 1 is also the most economical option as long as limiting the work season does not increase costs.

Option 2 is for stands between five and 420 acres and work before August 31st. The first surveys will be for marbled murrelet habitat surveys, and if suitable habitat is found, to be followed by presence/absence surveys. Survey costs for Option 2 will be low and performed by Fish and Wildlife staff.

Option 3 covers all three potentially impacted sensitive species: northern spotted owl, marbled murrelet and northern goshawk. Fish and Wildlife staff will first survey for suitable habitat, and if present, they will survey for detection of each species. Costs are greatest of all the three options but it covers the largest area and creates the most knowledge about species locations.

Buffers of 0.25 and 0.5 mile were installed around old-growth forest habitat greater than 420 acres in size (figure 7).

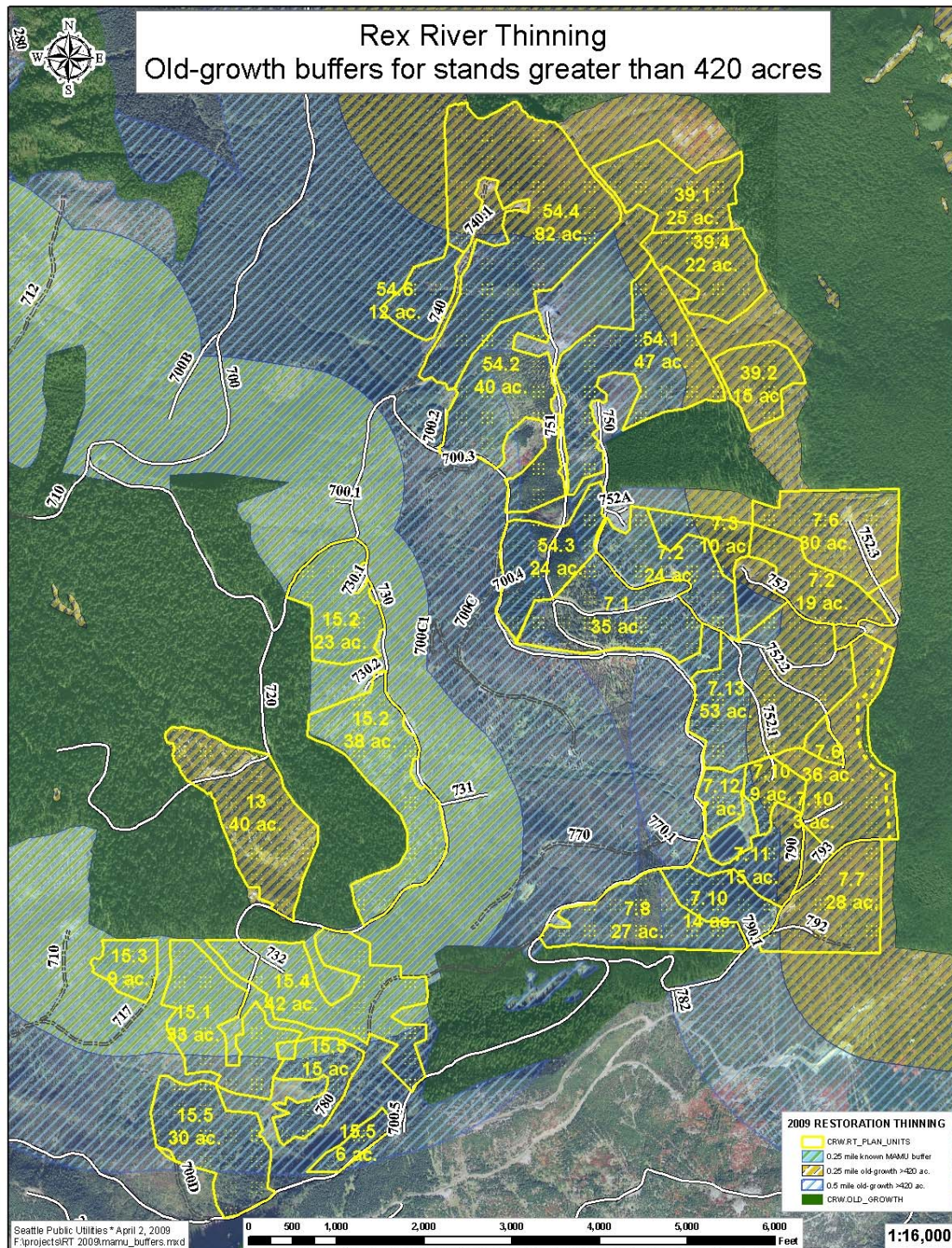


Figure 7. Locations of 0.25 and 0.5 mile buffers around old-growth forest habitat greater than 420 acres in size

Future planning for restoration thinning will diversify project locations over the CRMW landscape whenever possible to provide options for conducting thinning projects in the event that seasonal restrictions are necessary to protect sensitive species. Protection requirements will not be arbitrarily applied to late-seral patches that are deemed too small for spotted owl or northern goshawk nesting or to forest patches where marbled murrelets occupancy has not been documented. If future surveys document additional findings of SPOW, MAMU, or NOGO in the CRMW, staff will celebrate those findings and develop and implement appropriate protective measures.

7.1 Marbled Murrelet

Surveys have documented marbled murrelet occupancy (presumably nesting) in two old-growth forest patches in the upper Cedar River Municipal Watershed (CRMW). The first location is in the central Rex Basin old-growth and the second is adjacent to the main stem Cedar River near the confluence of the north and south forks. Since neither radar nor audio-visual surveys identified specific nest sites within these stands, the 0.25 mile buffer will extend outward from the outer perimeter of the old-growth forest patches. The HCP requires that within a 0.25 mile buffer around nest sites work may only occur between two hours after sunrise and two hours before sunset between April 1st and August 31st. Fish and Wildlife (F&W) staff recommend that we provide more conservative protection for these nesting sites and avoid all restoration thinning within the 0.25 mile buffer between April 1st and August 31st. After this date, work within the 0.25 mile buffer may proceed.

If restoration thinning work adjacent to other old-growth forest patches must be performed prior to August 31st, F&W staff will first determine whether the adjacent old-growth forest contains appropriate habitat for MAMU nesting. If the old growth forest contains little or no nesting habitat, it will not be surveyed for MAMU occupancy and restoration thinning work can proceed. If the appropriate nesting habitat is present, F&W staff will survey for MAMU occupancy in the old-growth forest patches adjacent to proposed restoration thinning work. If no occupancy is found, restoration thinning work may proceed. If occupancy is found, then the restrictions discussed above would apply.

7.2 Northern Spotted Owl

Surveys conducted in 2005 and 2008 detected no nesting pairs of northern spotted owl, but the 2008 survey did document a lone male on the east side of the Findley Lake basin. The owl was found in this area several times throughout the summer. The possibility exists that this male will find a mate and nest in one of the old-growth forest patches in the upper CRMW or that another pair will move in. There are four patches considered large enough (>450 acres) to support a SPOW pair: Meadow Mountain, Tinkham/Abiel/Baldy, Findley Lake, and Goat Mountain patches. There are two other patches smaller in size than the owls require, but still present a remote possibility for nesting habitat. These include the Rex Basin old-growth patch that provides high-quality

habitat and the McClellan Butte patch that abuts late-seral forest outside the CRMW boundary.

If work adjacent to old-growth forest other than those listed above must be performed prior to August 31st, F&W staff will survey for spotted owls within 0.25 miles of the edges of these larger old-growth forest patches that are adjacent to planned restoration thinning work. These surveys will occur early in the season, prior to commencement of any thinning. If a nest site is found, the HCP requires that no work occur within 0.25 mile of the nest between March 1st and August 31st.

If surveys detect no nest site but do detect a transient owl, then F&W staff will use their best judgment on how to proceed given the location, potential habitat configuration in that area, and anticipated level of potential disturbance impact due to planned activities. It is possible that seasonal restrictions for SPOW protection will result in delayed project implementation through August 31st in this case as well. If no SPOW are detected, then work can proceed.

7.3 *Northern Goshawk*

There is one documented northern goshawk nest site in the CRMW in the Meadow Mountain old-growth forest patch just east of the 500 road gravel pit. The HCP requires a 0.5 mile buffer around all NOGO nest sites where no potentially disturbing work within this buffer is allowed between April 1st and August 31st.

NOGO require larger old-growth forest patch sizes (>420 acres) for nesting. The six patches described for SPOW are also potential nesting habitat for NOGO.

Early in the season F&W staff will survey for NOGO within 0.5 miles of the edges of these larger old-growth forest patches that are adjacent to planned work. If nesting NOGO are found, a 0.5 mile buffer around the nest will be established and the above restrictions apply. If no NOGO are detected, work can proceed.

8.0 **Literature Cited**

Larson Andrew, J. and Derek Churchill. Unpublished manuscript. Spatial patterns of overstory trees in late-successional conifer forests.

Appendix A. Habitat Conservation Plan and Candidate Pool

1.0 Background – Restoration Philosophy

The focus of restoration in the Cedar River Municipal Watershed (CRMW) should be towards restoring ecological functions and processes, which are dynamic in time, rather than seeking to restore a particular suite of ecological attributes that may be present at a specific point in time. In restoring a disturbed ecosystem, we seek creation of ecosystems that support and enhance natural ecological functions and processes, even though these are not always well understood. We need to be thoughtful and explicit about what ecological functions and processes we are attempting to restore.

It is difficult to measure the key processes and functions in the natural environment. Therefore, in our restoration efforts we try to provide, enhance or emphasize the components or attributes that we assume to be necessary to support particular processes or functions. In more specific terms, we can alter the current tree growing conditions through our restoration thinning efforts and expect that the ‘restored’ habitat will be utilized now and into the future. We anticipate that by manipulating attributes (e.g. prescribing different tree densities and tree spacing patterns) across the previously altered landscape we are facilitating opportunities for key processes and their associated functions, such as complex forest habitat.

1.1 HCP Commitment

The writers of the HCP intended the restoration thinning program to address those areas within the CRMW that had been harvested in the recent past (1970-present; approximately 30 year old and younger trees). The 50-year HCP committed fifteen years of funding to treat approximately 10,480 acres under the restoration thinning program.

1.2 Restoration Thinning Goals and Objectives

Upland restoration thinning is the thinning of dense second-growth forest generally less than 30 years of age that have relatively low biological diversity and are in, or approaching, the competitive exclusion stage of forest succession. The primary goal of restoration thinning is to accelerate the development of complex habitat in the near-term and late-successional and old-growth forest conditions in the long-term. More specific objectives of restoration thinning include:

- Reduce competition among trees;
- Increase light penetration;
- Stimulate tree growth;
- Increase tree and understory plant species diversity;
- Reduce long-term fire hazard;
- Minimize the chance of catastrophic windthrow, insect, or disease outbreak;
- Accelerate forest development past the competitive exclusion state to a more biologically diverse stage, and/or;

- Extend the stand initiation period such that more diverse species and stand structures become established.

2.0 The Restoration Thinning Candidate Pool

In order to identify remaining restoration thinning candidates, a new system was developed in 2006 that incorporated remote sensing image data and a landscape-scale prioritization scheme. With approximately 6,000 acres already thinned, identifying and prioritizing the remaining acres become a necessity. This section describes how the restoration thinning candidate pool was created.

2.1 Identifying the Candidates

In 2006, watershed staff identified restoration thinning units utilizing LiDAR data which provides both ground surface imagery and vegetation surface imagery. The LiDAR ground surface model provides excellent topographic information and when combined with the vegetation surface images it provides information on average canopy height. Based on safety considerations, it was determined that the restoration thinning candidate pool would include stands of trees whose average canopy height was less than or equal to thirty feet. The LiDAR analysis identified over 12,000 acres in this pool, which is more than can be realistically treated by 2015.

2.2 Prioritizing the Candidates

Ecologists working in the CRMW struggled with how to prioritize restoration activities. In other words, where should restoration activities occur first and why during the implementation of the 50-year HCP? A landscape-scale prioritization effort was initiated by watershed staff in 2005 that facilitated the identification of high priority areas for restoration. The resulting GIS layer, called the Synergy Layer, identifies the highest synergy areas where there are overlaps among water bodies, riparian areas, old-growth forests, high functioning second-growth forests, and special habitats such as wetlands, rock outcrops and talus slopes.

The Synergy Layer was overlaid with the LiDAR derived restoration thinning candidate pool and the candidates ranked based on their Synergy “score”. The restoration thinning candidate with a rank of one has the greatest potential to provide important habitat improvement with appropriate restoration activities based on its nearness to high synergy areas. The prioritization and synergy analysis created 137 ranked candidate units.

To better understand current restoration thinning candidate composition, field data collection has been conducted in the first 100 ranked candidates. This field data collection includes tree measurements (species, height, diameter, and density), plant association determination, and historic stand information (stump species, diameter, and density). A significant number of candidates will not be thinned because of low tree density, too large of tree size, diverse species composition, and patchiness.

2.3 Sequencing Restoration Thinning with Road Decommissioning

The HCP road decommissioning program focuses on removing roads in the CRMW that are determined to be unnecessary for current or future operations as well as removing roads that cause sediment contributions to water bodies. Coordinating restoration thinning activities with the road decommissioning program is necessary to implementing restoration thinning cost-effectively, efficiently and safely. Conducting restoration thinning before road decommissioning makes better sense than decommissioning the road and sometime in the future requiring the contractor to walk to the restoration thinning unit.